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Residents of New York city who visited Cincinnati on the occasion of the meeting of the American Association for the Advancement of Science, doubtless returned with a better appreciation of the water supply of their own city.

Cincinnati draws its supply of water direct from the Ohio river, at a point within the city limits, and within a few yards of the outlet of a main sewer which discharges its abominations into the already discolored and muddy waters of the river.

Some idea may be formed of the condition of this water, when we state, that a small quantity poured into a washing basin, obscured the view of the bottom of the utensil, so opaque is the water by reason of its muddy impurity. And yet, the river at this time was at its best, for, undisturbed by rains or floods, it flowed past the city reduced to its lowest limits, and in its highest condition of purity.

Unanimity among the population of a large city on any one point, is not to be expected, but, it was with some surprise we heard expressions of admiration regarding this water, from some Cincinnatians. The majority of the people, however, were disgusted with the water supply of the city, and many were seeking their own remedy by the construction of artesian wells. The public press of Cincinnati, during our visit was loud in its denunciations of the evil, making excellent suggestions for obtaining the water supply from a purer source, and other needed improvements.

Recently the question has been much discussed, as to whether a city should draw its supply from a river, or from lakes and storage reservoirs. Which will give the best results?

This question is beset with many difficulties, and, in our opinion, cannot be determined in such a manner, that any particular decision for future guidance, *in all cases*, can be delivered. We apprehend that local causes and conditions which vary for every locality, having due weight and being well considered, should decide the question.

Of course absolute purity is not demanded, neither is it essential. The object to be aimed at, and that must be secured at any cost, is such a condition of purity which may be expressed by the term "fitness."

A water that is free from any impurities dangerous to health, of a good color and inodorous, may be considered "fit" for the supply of a city.

The question as to the best source for a supply of water, has of late received much attention from chemists and sanitary engineers. Reviewing the discussions, we express the opinion, that water drawn from a river which is free from sewage contaminations and not subject to discoloration, is preferable to water collected in lakes and storage reservoirs. The storage of water in reservoirs for long periods, without doubt, causes a deterioration in the quality of the water, generating a variety of animal and vegetable forms that are characteristic of stagnant waters, and which are dangerous to health. River water, on the contrary, if not contaminated directly near the source of supply, is usually free from those impurities which are most undesirable.

On this point we refer our readers to "Science," Vol. I. page 67, where will be found an analysis of the water supply of Newark, N. J., obtained from the river Passaic, contrasted with water used in that city, obtained from driven wells. The result showed that the water from the Passaic river, although contaminated with sewage to a certain extent, and below what may be considered a satisfactory condition, stood at the head of the list in regard to purity and general fitness for sanitary purposes. We believe that recently Professor Leeds, of Hoboken, has made analyses of the same waters, with very similar results.

But, from whatever source water may be obtained, a certain amount of manipulation appears to be essential before it is fit for distribution in a city. In the first place it should be held in a reservoir for 24 hours, to permit the suspended matter to subside; it should go through some simple process of filtration; and, lastly, be pumped to a sufficient elevation to secure a supply of water to the upper part of every house in the city.

The question of the public filtration of water for city use no doubt presents many difficulties, but until such filtration is accomplished by the authorities, every householder should make use of a filter, to cleanse from impurities, the water used for drinking and cooking purposes; for apart from the question of health, the interest of the public in securing pure water is

not confined to its use as an article of diet, because for all purposes for which water is employed, the purer it is, the better it is adapted for use.

THE CONNECTION OF THE BIOLOGICAL SCIENCES WITH MEDICINE.*

By T. H. Huxley, LL.D.

"The great man whose name is inseparably connected with the foundation of medicine, Hippocrates certainly knew very little—indeed, practically nothing—of anatomy or physiology; and he would probably have been perplexed even to imagine the possibility of a connection between the zoölogical studies of his contemporary, Democritus, and medicine. Nevertheless, in so far as he and those who worked before and after him in the same spirit ascertained, as matters of experience, that a wound or a luxation, or a fever, presented such and such symptoms, and that the return of the patient to health was facilitated by such and such measures, they established laws of Nature and began the construction of the science of pathology. All true science begins with empiricism, though all true science is such exactly in so far as it strives to pass out of the empirical stage into that of the deduction of empirical from more general truths. Thus, it is not wonderful that the early physicians had little or nothing to do with the development of biological science; and, on the other hand, that the early biologists did not much concern themselves with medicine. There is nothing to show that the Asclepiads took any prominent share in the work of founding anatomy, physiology, zoölogy and botany. Rather do these seem to have sprung from the early philosophers, who were essentially natural philosophers, animated by the characteristically Greek thirst for knowledge as such. Pythagoras, Alcmæon, Democritus, Diogenes of Apollonia, are all credited with anatomical and physiological investigation; and though Aristotle is said to have belonged to an Asclepiad family, and not improbably owed his taste for anatomical and zoölogical inquiries to the teachings of his father, the physician Nicomachus, the 'Historia Animalium,' and the treatise 'De Partibus Animalium,' are as free from any allusion to medicine as if they had issued from a modern biological laboratory.

"It may be added, that it is not easy to see in what way it could have benefited a physician of Alexander's time to know all that Aristotle knew on these subjects. His human anatomy was too rough to avail much in diagnosis, his physiology was too erroneous to supply data for pathological reasoning. But when the Alexandrian school, with Erasistratus and Herophilus at their head, turned to account the opportunities of studying human structure afforded to them by the Ptolemies, the value of the large amount of accurate knowledge thus obtained to the surgeon for his operations, and to the physician for his diagnosis of internal disorders, became obvious, and a connection was established between anatomy and medicine, which has ever become closer and closer. Since the revival of learning, surgery, medical diagnosis, and anatomy have gone hand in hand. Morgagni called his great work 'De Sedibus et Causis Morborum per Anatomen Indagatis,' and not only showed the way to search out the localities and the causes of disease by anatomy, but himself travelled wonderfully far upon the road. Bichat, discriminating the grosser constituents of the organs and parts of the body one from another, pointed out the direction which modern research must take; until at length histology, a science of yesterday, as it seems to many of us, has carried the work of Morgagni as far as the microscope can take us, and has extended the realm of pathological anatomy to the limits of the invisible world.

* International Medical Congress London, 1881.

"Thanks to the intimate alliance of morphology with medicine, the natural history of disease has, at the present day, attained a high degree of perfection. Accurate regional anatomy has rendered practicable the exploration of the most hidden parts of the organism, and the determination during life of morbid changes in them; anatomical and histological post-mortem investigations have supplied physicians with a clear basis upon which to rest the classification of diseases, and with unerring tests of the accuracy or inaccuracy of their diagnosis. If men could be satisfied with pure knowledge, the extreme precision with which, in these days, a sufferer may be told what is happening, and what is likely to happen, even in the most recondite parts of his bodily frame, should be as satisfactory to the patient as it is to the scientific pathologists who gives him the information. But I am afraid it is not; and even the practising physician, while nowise underestimating the regulative value of accurate diagnosis, must often lament that so much of his knowledge rather prevents him from doing wrong than helps him to do right. A scorner of physic once said that Nature and disease may be compared to two men fighting, the doctor to a blind man with a club, who strikes into the *mêlée* sometimes hitting the disease and sometimes hitting all Nature. The matter is not mended if you suppose the blind man's hearing to be so acute that he can register every stage of the struggle and pretty clearly predict how it will end. He had better not meddle at all until his eyes are opened—until he can see the exact position of the antagonists, and make sure of the effects of his blows. But that which it behooves the physician to see, not indeed with his bodily eye, but with clear intellectual vision, is a process, and the chain of causation involved in that process. Disease, as we have seen, is a perturbation of the normal activities of a living body; and it is and must remain unintelligible so long as we are ignorant of the nature of these normal activities. In other words, there could be no real science of pathology until the science of physiology had reached a degree of perfection unattained, and indeed unattainable, until quite recent times.

"So far as medicine is concerned, I am not sure that physiology, such as it was down to the time of Harvey, might as well not have existed. Nay, it is, perhaps, no exaggeration to say that, within the memory of living men, justly renowned practitioners of medicine and surgery knew less physiology than is now to be learned from the most elementary text book, and, beyond a few broad facts, regarded what they did know as of extremely little practical importance. Nor am I disposed to blame them for this conclusion; physiology must be useless, or worse than useless, to pathology, so long as its fundamental conceptions are erroneous. Harvey is often said to be the founder of modern physiology, and there can be no question that the elucidations of the function of the heart, of the nature of the pulse, and of the course of the blood, put forth in the ever-memorable little essay, 'De motu cordis,' directly worked a revolution in men's views of the nature and of the concatenation of some of the most important physiological processes among the higher animals, while indirectly their influence was perhaps even more remarkable. But, though Harvey made this signal and perennially important contribution to the physiology of the moderns, his general conception of vital processes was essentially identical with that of the ancients; and in the 'Exercitationes de generatione,' and notably in the singular chapter, 'De calido innato,' he shows himself a true son of Galon and of Aristotle. For Harvey, the blood possesses powers superior to those of the elements; it is the seat of a soul which is not only vegetative, but also sensitive and motor. The blood maintains and fashions all parts of the body, *idque summâ cum providentia et intellectu, in finem certum agens, quasi ratiocinio quodam uteretur.* Here is the doctrine of the *pneuma*, the product of the philosophical mould into which the animism of primitive men ran in Greece, in

full force. Nor did its strength abate for long after Harvey's time. The same ingrained tendency of the human mind to suppose that a process is explained when it is ascribed to a power of which nothing is known except that it is the hypothetical agent of the process, gave rise, in the next century, to the animism of Stahl; and later to the doctrine of a vital principle, that *asylum ignorantiæ* of physiologists, which has so easily accounted for everything and explained nothing, down to our own times.

"Now, the essence of modern, as contrasted with ancient physiological science, appears to me to lie in its antagonism to animistic hypotheses and animistic phraseology. It offers physical explanations of vital phenomena, or frankly confesses that it has none to offer. And, so far as I know, the first person who gave expression to this modern view of physiology, who was bold enough to enunciate the proposition that vital phenomena, like all the other phenomena of the physical world, are in ultimate analysis, resolvable into matter and motion, was René Descartes. The fifty-four years of life of this most original and powerful thinker are widely over-lapped on both sides by the eighty of Harvey, who survived his younger contemporary by seven years, and takes pleasure in acknowledging the French philosopher's appreciation of his great discovery. In fact, Descartes accepted the doctrine of the circulation as propounded by 'Hervæus, médecin d'Angleterre,' and gave a full account of it in his first work, the famous 'Discours de la Méthode,' which was published in 1637, only nine years after the exercitation 'De motu cordis;' and, though differing from Harvey in some important points (in which it may be noted, in passing, Descartes was wrong and Harvey right), he always speaks of him with great respect. And so important does the subject seem to Descartes, that he returns to it in the 'Traité des Passions,' and in the 'Traité de l'Homme.'

"It is easy to see that Harvey's work must have had a peculiar significance for the subtle thinker, to whom we owe both the spiritualistic and the materialistic philosophies of modern times. It was in the very year of its publication, 1628, that Descartes withdrew into that life of solitary investigation and meditation of which his philosophy was the fruit; and, as the course of his speculations led him to establish an absolute distinction of Nature between the material and the mental worlds, he was logically compelled to seek for the explanation of the phenomena of the material world within itself, and having allotted the realm of thought to the soul, to see nothing but extension and motion in the rest of Nature. Descartes uses 'thought' as the equivalent of our modern term 'consciousness.' Thought is the function of the soul, and its only function. Our natural heat and all the movements of the body, says he, do not depend on the soul. Death does not take place from any fault of the soul, but only because some of the principal parts of the body become corrupted. The body of a living man differs from that of a dead man in the same way as a watch or other automaton (that is to say, a machine which moves of itself) when it is wound up, and has in itself the physical principal of the movements which the mechanism is adapted to perform, differs from the same watch or other machine when it is broken, and the physical principle of its movements no longer exists. All the actions which are common to us and the lower animals depend only on the conformation of our organs and the course which the animal spirits take in the brain, the nerves, and the muscles, in the same way as the movement of a watch is produced by nothing but the force of its spring and the figure of its wheels and other parts.

"Descartes' treatise on 'Man' is a sketch of human physiology in which a bold attempt is made to explain all the phenomena of life, except those of consciousness, by physical reasonings. To a mind turned in this direction Harvey's exposition of the heart and vessels as a hydraulic mechanism must have been supremely welcome. Descartes was not a mere philosophical theorist, but a hard-working dissector and experimenter, and he held the strongest opinion respecting the practical value of the new conception which he was introducing. He speaks of the importance of preserving health, and of the dependence of the mind on the body being so close that perhaps the only way of making men wiser and better than they are is to be sought in medical science. 'It is true,' says he, 'that as medicine is now practised it contains little that is very useful; but without any desire to depreciate, I am sure that there is no one, even among professional men, who will not declare that all we know is very little as compared with that which remains to be known; and that we might escape an infinity of diseases of the mind, no less than of the body, and even perhaps the weakness of old age, if we had a sufficient knowledge of their causes and of all the remedies with which nature has provided us.'* So strongly impressed was Descartes with this that he resolved to spend the rest of his life in trying to acquire such a knowledge of nature as would lead to the construction of a better medical doctrine.* The anti-Cartesians found material for cheap ridicule in these aspirations of the philosopher; and it is almost needless to say that, in the thirteen years which elapsed between the publication of the 'Discours' and the death of Descartes, he did not contribute much to their realization. But for the next century all progress in physiology took place along the lines which Descartes laid down.

"The greatest physiological and pathological work of the seventeenth century, Borelle's treatise 'De motu animalium,' is, to all intents and purposes, a development of Descartes' fundamental conception; and the same may be said of the physiology and pathology of Boerhaave, whose authority dominated in the medical world in the first half of the eighteenth century. With the origin of modern chemistry and electrical science, in the latter half of the eighteenth century, aids in the analysis of the phenomena of life, of which Descartes could not have dreamed, were offered the physiologist. And the greater part of the gigantic progress which has been made in the present century is a justification of the provisions of Descartes. For it consists essentially in a more and more complete resolution of the grosser organs of the living body into physico-chemical mechanisms. 'I shall try to explain our whole bodily machinery in such a way that it will be no more necessary for us to suppose that the soul produces such movements as are not voluntary than it is to think that there is in a clock a soul which causes it to show the hours.'† These words of Descartes might be appropriately taken as a motto by the author of any modern treatise on physiology.

"But though, as I think, there is no doubt that Descartes was the first to propound the fundamental conception of the living body as a physical mechanism, which is the distinctive feature of modern as contrasted with ancient physiology, he was misled by the natural temptation to carry out, in all its details, a parallel between the machines with which he was familiar, such as clocks and pieces of hydraulic apparatus and the living machine. In all such machines there is a central source of power, and the parts of the machine are merely passive distributors of that power. The Cartesian school conceived of the living body as a machine of this kind; and herein they might have learned from Galen, who, whatever ill use he may have made of the doctrine of "natural faculties," nevertheless had the great merit of perceiving that local forces play a great part in physiology. The same truth was recognized by Glisson, but it was first prominently brought forward in the Hallerian doctrine of the 'vis insita' of muscles. If muscle can contract without nerve, there is an end of the Cartesian me-

* Discours de la Méthode. 6mo. partie. Ed. Cousin. P. 193.

† De la Formation du Fœtus.

chanical explanation of its contraction by the influx of animal spirits.

"The discoveries of Trembley tended in the same direction. In the fresh water *Hydra* no trace was to be found of that complicated machinery upon which the performance of the functions in the higher animals was supposed to depend. And yet the hydra moved, fed, grew, multiplied, and its fragments exhibited all the powers of the whole. And, finally, the work of Caspar F. Wolff,‡ by demonstrating the fact that the growth and development of both plants and animals take place antecedently to the existence of their grosser organs, and are, in fact, the causes and not the consequences of organization (as then understood), sapped the foundations of the Cartesian physiology as a complete expression of vital phenomena. For Wolff, the physical basis of life is a fluid, possessed of a " vis essentialis ' and a ' solidescibilitas ;' in virtue of which it gives rise to organization ; and, as he points out, this conclusionstrikes at the root of the whole iatro-mechanical system.

"In this country the great authority of John Hunter exerted a similar influence, though it must be admitted that the too sibylline utterances which are the outcome of Hunter's struggles to define his conceptions are often susceptible of more than one interpretation. Nevertheless, on some points Hunter is clear enough. For example, he is of opinion that 'spirit is only a property of matter' ('Introduction to Natural History,' page 6), he is prepared to renounce animism (l. c., p. 8), and his conception of life is so completely physical that he thinks of it as something which can exist in a state of combination in the food. 'The aliment we take in has in it, in a fixed state, the real life, and this does not become active until it has got into the lungs, for there it is freed from its prison' (Observations on Physiology,' p. 113). He also thinks that: 'It is more in accord with the general principles of the animal machine to suppose that none of its effects are produced from any mechanical principle whatever, and that every effect is produced from an action in the part, which action is produced by a stimulus upon the part which acts, or upon some other part with which this part sympathizes, so as to take up the whole action' (l. c., p. 152). And Hunter is as clear as Wolff, with whose work he probably was unacquainted, that 'whatever life is, it most certainly does not depend upon structure or organization' (l. c. p. 114).

"Of course, it is impossible that Hunter could have intended to deny the existence of purely mechanical operations in the animal body. But while with Borelli and Boerhaave, he looked upon absorption, nutrition, and secretion as operations effected by means of the small vessels, he differed from the mechanical physiologists, who regarded these operations as the result of the mechanical properties of the small vessels, such as the size, form, and disposition of their canals and apertures. Hunter, on the contrary, considers them to be the effect of properties of these vessels which are not mechanical, but vital. 'The vessels,' says he, 'have more of the polypus in them than any other part of the body,' and he talks of the 'living and sensitive principles of the arteries,' and even of the 'dispositions or feelings of the arteries.' 'When the blood is good and genuine, the sensations of the arteries, or the dispositions for sensation, are agreeable. . . . It is then they dispose of the blood to the best advantage, increasing the growth of the whole, supplying any losses, keeping up a due succession, etc.' (l. c., p. 133).

"If we follow Hunter's conceptions to their logical issue, the life of one of the higher animals is essentially the sum of the lives of all the vessels, each of which is a sort of physiological unit, answering to a polyp; and, as health is the result of the normal "action of the vessels," so is disease an effect of their abnormal action. Hunter thus stands in thought, as in time, midway between Borelli, on the one hand, and Bichat, on the other. The acute founder of general anatomy, in fact, outdoes Hunter in his desire to exclude physical reasonings from the realm of life. Except in the interpretation of the action of the sense organs, he will not allow physics to have anything to do with physiology. 'To apply the physical sciences to physiology is to explain the phenomena of living bodies by the laws of inert bodies. Now, this is a false principle, hence all its consequences are marked with the same stamp. Let us leave to chemistry its affinity, to physics its elasticity and its gravity. Let us invoke for physiology only sensibility and contractility'* Of all the unfortunate dicta of men of eminent ability this seems one of the most unhappy, when we think of what the application of the methods and the data of physics and chemistry has done towards bringing physiology into its present state. It is not too much to say that one half of a modern text-book of physiology consists of applied physics and chemistry, and that it is exactly in the exploration of the phenomena of sensibility and contractility that physics and chemistry have exerted the most potent influence.

"Nevertheless, Bichat rendered a solid service to physiological progress by insisting upon the fact that what we call life in one of the higher animals is not an invisible unitary archæus dominating from its central seat the parts of the organism, but a compound result of the synthesis of the separate lives of those parts. 'All animals,' says he, 'are assemblages of different organs, each of which performs its function and concurs, after its fashion, in the preservation of the whole. They are so many special machines in the general machine which constitutes the individual. But each of these special machines is itself compounded of many tissues of very different natures, which, in truth, constitute the elements of these organs (l. c., lxxix.) The conception of a proper vitality is applicable only to these simple tissues, and not to the organs themselves (l. c., lxxxiv.).' And Bichat proceeds to make the obvious application of this doctrine of synthetic life, if I may so call it, to pathology. Since diseases are only alterations of vital properties, and the properties of each tissue are distinct from those of the rest, it is evident that the diseases of each tissue must be different from those of the rest. Therefore, in any organ composed of different tissues, one may be diseased and the other remain healthy, and this is what happens in most cases (l. c., lxxxv.). In a spirit of true prophecy, Bichat says: 'We have arrived at an epoch in which pathological anatomy should start afresh.' For, as the analysis of the organ had led him to the tissues as the physiological units of the organism, so, in a succeeding generation, the analysis of the tissues led to the cell as the physiological element of the tissues. The contemporaneous study of development brought out the same result, and the zoölogists and botanists, exploring the simplest and the lowest forms of animated beings, confirmed the great induction of the cell theory. Thus the apparently opposed views which have been battling with one another ever since the middle of the last century have proved to be each half a truth.

"The proposition of Descartes, that the body of a living man is a machine, the actions of which are explicable by the known laws of matter and motion, is unquestionably largely true. But it is also true that the living body is a synthesis of innumerable physiological elements, each of which may nearly be described in Wolff's words, as a fluid possessed of a *vis essentialis*, and a *solidescibilitas*; or, in modern phrase, as protoplasm susceptible of structural metamorphosis and functional metabolism; and that the only machinery, in the precise sense in which the Cartesian school understood mechanism, is that which co-ordinates and regulates

‡ Theoris Generationis, 1759.

* Anatomie générale, i., p. liv.

these physiological units into an organic whole. In fact, the body is a machine of the nature of an army, not of that of a watch, or of a hydraulic apparatus. Of this army, each cell is a soldier, an organ a brigade, the central nervous system headquarters and field telegraph, the alimentary and circulatory system the commissariat. Losses are made good by recruits born in camp, and the life of the individual is a campaign, conducted successfully for a number of years, but with certain defeat in the long run.

"The efficacy of an army at any given moment depends on the health of the individual soldier, and on the perfection of the machinery by which he is led and brought into action at the proper time; and, therefore, if the analogy holds good, there can be only two kinds of diseases, the one dependent on abnormal states of the physiological units, the other on perturbation of their co-ordinating and alimentative machinery. Hence, the establishment of the cell theory in normal biology was swiftly followed by a 'cellular pathology' as its logical counterpart. I need not remind you how great an instrument of investigation this doctrine has proved in the hands of the man of genius, to whom its development is due, and who would probably be the last to forget that abnormal conditions of the co-ordinative and distributive machinery of the body are no less important factors of disease. Henceforward, as it appears to me, the connection of medicine with the biological sciences is clearly defined. Pure pathology is that branch of biology which defines the particular perturbation of cell-life, or of the co-ordinating machinery, or of both, on which the phenomena of disease depend.

"Those who are conversant with the present state of biology will hardly hesitate to admit that the conception of the life of one of the higher animals as the summation of the lives of a cell-aggregate, brought into harmonious action by a co-ordinative machinery formed by some of these cells, constitutes a permanent acquisition of physiological science. But the last form of the battle between the animistic and the physical views of life is seen in the contention whether the physical analysis of vital phenomena can be carried beyond this point or not.

"There are some to whom living protoplasm is a substance even such as Harvey conceived the blood to be, *summâ cum providentia et intellectu in finem certum agens, quasi ratiocinio quodam;* and who look, with as little favor as Bichat did, upon any attempt to apply the principles and the methods of physics and chemistry to the investigation of the vital processes of growth, metabolism, and contractility. They stand upon the ancient ways; only, in accordance with that progress toward democracy which a great political writer has declared to be the fatal characteristic of modern times, they substitute a republic formed by a few billion of 'animulæ' for the monarchy of the all-pervading 'anima.' Others, on the contrary, supported by a robust faith in the universal applicability of the principles laid down by Descartes, and seeing that the actions called 'vital' are, so far as we have any means of knowing, nothing but changes of place of particles of matter, look to molecular physics to achieve the analysis of the living protoplasm itself into a molecular mechanism. If there is any truth in the received doctrine of physics, that contrast between living and inert matter, on which Bichat lays so much stress, does not exist. In nature nothing is at rest, nothing is amorphous; the simplest particle of that which men in their blindness are pleased to call 'brute matter' is a vast aggregate of molecular mechanisms, performing complicated movements of immense rapidity, and sensitively adjusting themselves to every change in the surrounding world. Living matter differs from other matter in degree and not in kind; the microcosm repeats the macrocosm; and one chain of causation connects the nebulous original of suns and planetary systems with the protoplasmic foundation of life and organization. From this point of view pathology is the analogue of the theory of perturbations in astronomy; and therapeutics resolves itself into the discovery of the means by which a system of forces competent to eliminate any given perturbation may be introduced into the economy. And as pathology bases itself upon normal physiology, so therapeutics rests upon pharmacology, which is, strictly speaking, a part of the great biological topic of the influence of conditions on the living organism, and has no scientific foundation apart from physiology.

"It appears to me that there is no more hopeful indication of the progress of medicine toward the ideal of Descartes than is to be derived from a comparison of the state of pharmacology at the present day with that which existed forty years ago. If we consider the knowledge positively acquired in this short time of the ***modus operandi*** of urari, of atropia, of physostigmin, of veratria, of casca, of strychnia, of bromide of potassium, of phosphorus, there can surely be no ground for doubting that, sooner or later, the pharmacologist will supply the physician with the means of affecting, in any desired sense, the functions of any physiological element of the body. It will, in short, become possible to introduce into the economy a molecular mechanism which, like a very cunningly contrived torpedo, shall find its way to some particular group of living elements, and cause an explosion among them, leaving the rest untouched. The search for the explanation of diseased states in modified cell-life; the discovery of the important part played by parasitic organisms in the etiology of disease; the elucidation of the action of medicaments by the methods and the data of experimental physiology—appear to me to be the greatest steps which have ever been made toward the establishment of medicine on a scientific basis. I need hardly say they could not have been made except for the advance of normal biology.

"There can be no question, then, as to the nature or the value of the connection between medicine and the biological sciences. There can be no doubt that the future of pathology and of therapeutics, and therefore that of practical medicine, depend upon the extent to which those who occupy themselves with these subjects are trained in the methods, and impregnated with the fundamental truths, of biology.

"And, in conclusion, I venture to suggest that the collective sagacity of this Congress could occupy itself with no more important question than with this. How is medical education to be arranged, so that, without entangling the student in those details of the systematist which are valueless to him, he may be enabled to obtain a firm grasp of the great truths respecting animal and vegetable life, without which, notwithstanding all the progress of scientific medicine, he will still find himself an empiric?"

NOTES ON EXPERIMENTAL CHEMISTRY.*

By Professor Albert B. Prescott.

I. Determinations of the limits of (1), temperature in solution; (2), temperature in dry state; (3), alcoholic fermentation; and (4), acidity, compatible with the starch converting power of diastase of barley malt.

II. Determinations of the solubility of precipitated aluminium hydrate in excess of ammonium hydrate, with and without ammonium chloride.

In a paper by M. L. Boudenoot in the *Nouvelles Annales de la Construction*, describing the various forms of explosives of the nitro-cellulose class, a new compound is mentioned, called by its inventor, M. Anders, gelatino-diaspon. It is composed of wood-cellulose and nitro-glycerine, is unaffected by cold, is not sensible to blows or shocks, and explodes only by a sudden increase of temperature to about 160° C. (320° Fahr.) It burns quietly when ignited in the open air, and is not injured by water.

* Read before the A. A. A. S., Cincinnati, 1881.

THE PARIS ELECTRICAL EXHIBITION.

[From Our Paris Correspondent.]

To the Editor of "SCIENCE."

This letter leaves Paris somewhat late, considering the official opening of the Electrical Exhibition took place eight days ago, and that the opening to the public followed the next day, viz., the 11th of August, but in fact the exhibition is not opened even yet, although the public is admitted during some hours of the day to look at the half-finished structures and to inspect the dust-covered instruments.

The daily newspapers and some so-called scientific papers, which give to their readers sensational articles rather than correct information, have been for about ten days crowded with descriptions of the opening and the progress of the electrical exhibition, but the real good scientific papers have hitherto only given short notes, because it has, as yet, been impossible to study the value of the different instruments in the exhibition building, where everything is still in a half-finished state and where the noise of hammers and carpenters' instruments are still heard in every corner.

Notwithstanding this, I will endeavor to give you in this letter a description of the actual state of the exhibition, which will serve your readers as an introduction to the more special articles with which I will furnish your paper weekly.

When we first enter the Palais de l'Industrie through the principal pavilion, which is situated on the side of the Champs Elysées, we observe a series of beautiful statues which serve as "candelabres" for lamps of the Werdermann system, and when we approach the entrance to the great nave our eyes are attracted with two enormous images representing a male and female lion, while we observe above our head a beautiful chandelier of iron wrought in tasteful style, furnished with Siemens lamps. This lustre will undoubtedly be very attractive if the arrangements for the light are made as carefully by the French firm of the well-known house of Siemens, as those in the German department, where some evenings ago the preliminary experiments made with the Siemens lamps attracted the general admiration of all those who had the privilege to witness them.

In the centre of the nave a light-house is erected, which is a copy of the light-houses that guard the coasts of France. It is surrounded by a small water-basin, which, although it may be called ornamental, is perfectly useless for the purpose for which it is destined, on account of its limited dimensions and the outlines of its borders, which form a star. This basin is intended as a field of exercise for the boat of M. Trouvé, called the *Telephon*, which is driven by an electric motor, in connection with a Bunsen battery, and the length of which nearly equals the radius of the circumference of the basin.

I may here say a few words about M. Trouvé's boat, on account of which a good deal of nonsense has been published in European and American papers, one of the latter mentioning not long ago that M. Trouvé's boat, with which he experimented upon the Seine, contained a battery of M. Faure, but M. Trouvé is too well acquainted with the value of scientific instruments to depreciate the merits of the Planté battery and to substitute for it Faure's modification, as long as the former is better.

Count Du Moncel, whose name is well known among all electricians, on account of his excellent work on the "Application of Electricity," which is the most complete work of its kind in existence, and also on account of his other numerous publications and inventions relating to this part of Science, presented on the 7th of July last a note to the Academy of Sciences, in which M. Trouvé describes in a very precise manner the motor used by him in propelling a little boat. This note will give to your readers exact and correct information regarding the merits and properties of the motor used in the little canoe which is now seen in the Electrical Exhibition, and I therefore quote this note verbatim:

"A motor having a weight of 5 kilogrammes and in connection with six elements of a secondary battery of Planté, which produces a labor of 7 kilogrammeters per second, was placed on the 8th of last April upon a tricycle, which latter, rider and battery included, had a weight of 160 kilogrammes, and gave to the vehicle a celerity of 12 kilometers per hour."

"The same motor, used on the 26th of May, in a boat having a length of 5.50 meters and a breadth of 1.20 meters, holding three persons, gave to this boat a celerity of 2.50 meters in descending the Seine at Pont-Royale and of 1.50 meter in moving against the current. The motor obtained its electro-motive power by means of two batteries, consisting each of 6 elements of bichromate of potash, and the propeller was furnished with a coil having 3 branches.

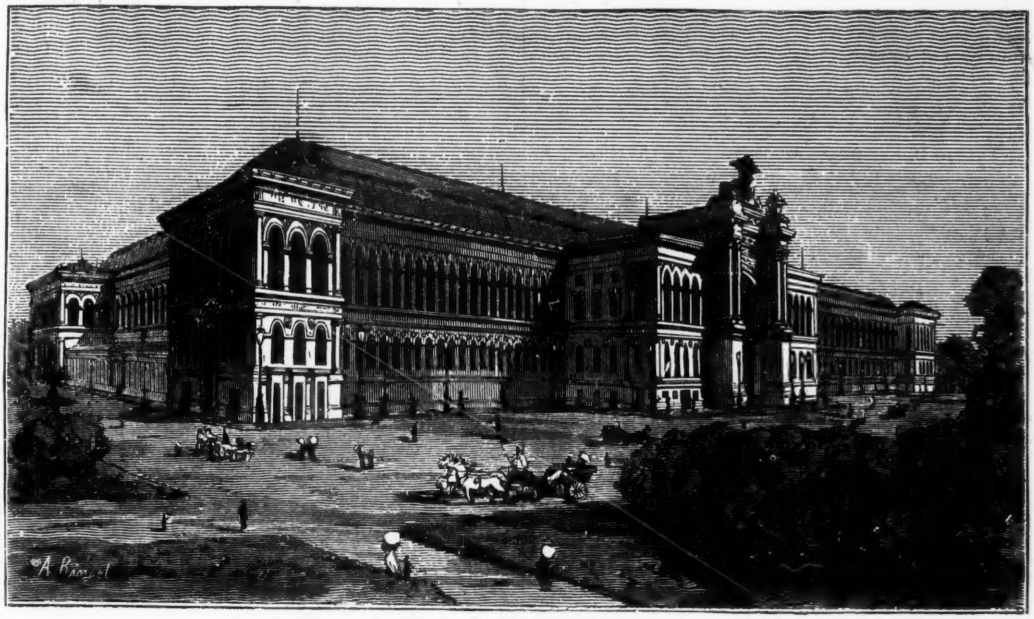
"On the 26th of June I renewed the experiment upon the quiet waters of the upper lake of the Bois de Bologne, using a coil with 4 branches having diameters of 0.28 meter and being in connection with 12 elements of Bunsen with flat plates such as are used in the Ruhmkorff battery. The liquid of these elements consisted of one part of hydrochloric-acid, one part of nitric acid, and two parts of water in the porous vessel, in order to diminish the disengagement of hypoazotic vapors.

"The celerity of the little boat, which was measured with an ordinary log, rose in the commencement to 150 meters within 48 seconds, or a little more than 3 meters per second; but after three hours of working it had diminished to 150 meters during 55 seconds. After five hours of working the electricity was still 2.30 meters per second."

So much about M. Trouvé's boat, of which a number of miniature specimens, in good working order, may be seen in the upper story of the Exposition building.

At the left-hand side of the nave, nearest to the light-house, are the exhibitions of Great Britain, Germany and the United States. The exhibition of Germany is that which has the most imposing appearance and is also that which was first completed. Two enormous "candelabres" in forged iron ornament the entrance of the department, and contain lamps of "Gebrueder Siemens" of Berlin. Near them stand two trophies crowned with the Prussian eagle, and behind them, upon a large number of tables, may be seen a collection of electrical instruments of all kinds, which we will describe in our reports hereafter. At the right-hand side of the department we see the busts of five German pioneers in the field of Electrical Science, viz.: Otto von Guericke, Ohm, Sömmering, Steinheil, and Gauss.

The historical collection of instruments in the German department is of the highest interest in a retrospective way. I will only mention an exact copy of the first machine for static electricity, constructed in the year 1670 by Otto von Guericke, consisting of a sulphur globe, which was electrified by turning it by means of an axis and using the hand as a rubber; an electrical egg, so-called, property of Prince Pless, of Germany, and constructed at the commencement of the 18th century; an electro-chemical apparatus for telegraphing, constructed by Thomas Sömmering in Munich in the year 1809—the telegraphing with this instrument is done by the decomposition of water. A magneto-electric telegraph of Gauss and Weber, constructed in 1833—this telegraph was used in 1837 in order to keep up a telegraphic communication between the physical laboratory aud the magnetical observatory in the University of Göttingen; the copy of the first telephone ever constructed, and invented in the year 1861 by Reis, and a great many other apparatus of equal interest.



EXTERIOR.

INTERIOR.

ELECTRICAL EXHIBITION.—PARIS, 1881.

Amongst the other electrical instruments in the front part of the department, especially worthy of attention, are some of the most important instruments used in the physiological institution of Berlin and mostly due to the genius of the celebrated German professor "Dubois-Reymond" of Berlin. These instruments will be used in experiments before the French Academy of Sciences and the Electric Congress, by Professor Arthur Christianï, of the Medical Faculty of the Berlin University, who has been sent for this purpose to Paris and arrived here a few days ago.

A large space in the German department is occupied by the extensive exhibitions of the firm of Siemens & Halske of Berlin, and there may be also seen the first electro-locomotive constructed by this firm in the year 1867 and the first machine of that renowned type, which was invented at nearly the same time by Mr. Wheatstone in England and Mr. Siemens in Berlin.

The exhibit of Mr. Siemens is, in my opinion, one of the most important of all the exhibits in the whole building of the Palais de l' Industrie, and the excellent instruments and apparatus manufactured by this firm, which occupy a large place in the German, French and English departments of the exhibition create general admiration. I shall endeavor, during the following week, to furnish you with an explicit description of some of the more important instruments of the Siemens exhibition and your readers will then be able to judge for themselves of their value.

The exhibition of *Great Britain* is still far from being complete, and this is very easily explained, by the fact that the English government, although after a very long hesitation, finally having taking part in the exhibition has not consented to contribute anything for the expenses, and it is marvellous that under such circumstances the English exhibitors have been able to contribute so much as they have. The only portion of the English exposition which is nearly complete is that of Siemens Brothers, who, among other things, exhibit a great number of apparatus for submarine telegraphy which are displaved on several large tables, and of which the most conspicuous is a full sized buoy ornamented with a flag. One fact which I must not forget to mention, is, that the pavilion of the British post-office is undoubtedly erected in excellent taste and is not only the most conspicuous but also the most beautiful in the exhibition (with the exception of the pavilions of the Italians). This pavilion is divided into two parts, the one containing a historical collection which is very remarkable and consists of the first instruments of telegraphy, among others that ingenious telegraph apparatus of Cook and Wheatstone, which was used with several wires and which now, after the invention of duplex, quadruplex and multiplex systems seems rather primitive, while the other part consists of a collection of all the modern instruments of telegraphy which can only be appreciated by a more minute description, and a great help to the study of these instruments is their excellent arrangement, which is due to the labors of Mr. Preece.

The exhibition of the United States is not at all what it should be, and it is greatly to be regretted that Europeans will receive a very wrong impression of the productiveness of your country if they judge by the scanty exhibits which America has sent to the Paris exhibition.

Most of the Americans to whom I have spoken seem to recognize this fact very fully, and it is generally regretted that many of the beautiful electrical inventions of the United States cannot be displayed here, where they would certainly create a sensation. But it seems that the United States Government was too interested in politics to care for a worthy representation at the electrical exhibition, and the more intelligent class of the French public know how to appreciate the difficulties with which the American exhibitors had to contend on this account, as well as on account of the great distance which separates their country from Europe.

Among the apparatus, which are already installed, may be mentioned the Bell telephone, the automatic time-register and alarm, the Dolbear telephone, of which you have already given a long description in your paper, and which is now exhibited in a neat little pavilion erected by Mr. Buck and Mr. Stetson, who, by their industry, set an example to the tardy French workmen; and the exhibition of the United States Signal Service, which contains an ingeniously constructed distance-barometer, anemoscope and anemometer, invented by Mr. Eccard. The display of the other exhibitors are not yet finished, and I reserve that of Mr. Edison's until it is more complete, as it promises to be the most interesting and valuable one in the building, and will demand a special report to do it justice.

If we continue our walk through the Exhibition towards the East Entrance, we come to the department of Belgium and Austria. That of Belgium offers a very beautiful aspect, and is displayed in two fine pavilions, which are furnished with several crystal cases ornamented by copper posts. The galvano-plastic exhibits in this department are worthy of the greatest attention, but scientifically, the most interesting exhibit is that of the meteorological station of Brussels. Austria has contributed a great many apparatus which serve for the security of railways.

The pavilion of Italy, which we next enter, is a beautiful oblong building, and attracts much attention. Until yesterday it was nearly empty, but the instruments begin now to be installed, and within a few days the visitors of the Exhibition will have the privilege of seeing the ingenious instruments that Volta, Gulvani and Nobili constructed with their own hands, and to read the original letters in which these great scientists published their first ideas regarding their new and wonderful discoveries. This Italian pavilion, in connection with the post office pavilion of England and the retrospective collection of the Germans, form together the material for the three most important chapters in the history of electricity.

The exhibition of Holland offers, so to say, an appendix to them, and the instruments for static electricity there shown, excel, perhaps not in quality, but at least in grandeur all other instruments of this kind. The enormous machine and battery of Leyden-bottles of Van Marum, of which we have all heard when we were school boys, form the most interesting part of this exhibition, and the whole, including the enormous natural magnets, makes upon the visitor an impression that he is visiting an exhibition of the Scientists of the land of the pyramids.

Passing the departments of Spain and Switzerland, and leaving at the left the exhibition of Russia and Norway, which have all contributed in an appreciable manner to the interesting show of apparatus, we arrive at the entrance station of the Siemens' electrical railway which is not yet completed on account of several modifications which his construction had to undergo. It will be running, however, within a few days.

Returning now again to the centre of the nave, and entering the western half of the building, we see before us the French portion of the exhibition.

At the left hand side viewed from the light-house, is a pavilion in very good taste filled with the shining silver and gold exhibits, and with the highly artistic galvano-plastic reproductions of the renowned firm of Christofle & Co., and on the right hand side from the light-house in a pavilion corresponding exactly in style with the former, we see the exhibits of the Jablochkoff Electric Light Company. This department contains a complete collection of all the different kinds of apparatus used by this company, and amongst others a new dynamo-electric machine of Jablochkoff, which is of excellent consttron.

The pavilion of the *City of Paris* contains instruments for the distribution of time and electrical instruments for the service of the fire companies. This pavilion is surrounded by the exhibitions of different French railroad lines, which contain an enormous amount of apparatus too complicated and too numerous to mention in this short review.

One of the most interesting parts of the French exhibition is the pavilion of the Ministry of Posts and Telegraphs, which contains a complete collection of all the modern apparatus employed in the telegraph service of France. This pavilion is bounded on its North, South and East sides by highly interesting collections of different French firms, while on its West side the great staircase leads to the upper stories. Of the exhibits in the upper story I will give only a general catalogue because the installments are as yet too unfinished to render it possible to give any detailed description of them, and the experiments with the electric lights and telephones, to which this portion of the palace is mostly dedicated, will not commence before eight days.

Hall A, immediately opposite to the grand staircase, is a beautifully furnished drawing room called the "Salon du President" and will be lighted by the Werdermann light.

Hall 1 contains a gallery of paintings but it is to be hoped that the light of the "Lampe-Soleil" which is here exhibited will be better than the pictures, which are wretchedly bad.

Hall 2 contains a stage which once figured in the, so-called, "Athenæum," in the "Rue des Martyrs." This stage will be used for showing stage effects produced by electric lights, and the light will be furnished by the Werdermann Company.

Hall 3 is a tastefully furnished dining-room, with table temptingly set, in which the Werdermann light will also be displayed.

Hall 4 is an apartment consisting of vestibule, kitchen and bathing-room, which will be lighted by incandescent lamps fed from reservoirs consisting of Faure's secondary battery and furnished by "La Société de la Force, et la Lumière."

I have made it a special object to study the value of the Faure-battery in regard to which so much has been said pro and contra, and propose to furnish your excellent paper with impartial reports on this subject as soon as any definite knowledge of it can be obtained.

Halls 5 and 6, which are united in one, will display lights of the "Systeme-Jamin" and contain a collection of Gramme-machines modified by M. Jamin.

Hall B contains a collection of smaller electrical apparatus, of electrical toys and also an exhibition of Jablochkoff candles.

Halls 7 and 8 are dedicated to telephone experiments, hall 7, being lighted by "La Société de la Force et la Lumière" while the light of hall 8, is furnished by Mr. Brush. The preliminary experiments with the telephones in these halls have been exceedingly satisfactory, the music of the Grand Opera and the words spoken in the "Théatre-Francais" (both of these buildings being connected by telephone-wires with halls) can be so plainly heard that one may really imagine himself to be one of the audience present, instead of being several kilometers distant from the places of performance. A person, who has never witnessed these telephone experiments can have no idea of the value of the microphone and telephone, and the public, before which these experiments will be made in about eight days, will be greatly astonished to see those reports verified which it has hitherto taken for exaggerated descriptions of sanguine writers.

Hall 9 contains chiefly electrical apparatus devoted to medical purposes, and will be lighted by Méritens, who also has there exhibited the most of his special apparatus.

Hall 10 is dedicated to the exhibition and the light of the firm of "Sautter et Lemonnier."

Hall 11 has Jablochkoff light and will also exhibit the apparatus used for photographing by electric light.

Hall 12 will be lighted by the Spanish society of electricity which employs Gramme's lamps.

Hall 13 serves for the display of Siemens' differential lamps and contains an excellent collection of instruments of precision and of Geissler tubes.

Hall 14 contains machines of the system Wilde and Alliance, it will be lighted by means of Wilde's candles, furnished by the Parisian Company of Wilde's light.

Hall C contains cables, telephones, and telegraph instruments and will be lighted by incandescent lamps of Maxim furnished by the United States Electric Lighting Company.

Hall 15 has, among other things, a nice collection of lightning-rods and contains Jaspar's light.

Hall 16 has lamps of M. Anatole Gérard.

Hall 17 contains electro-chemical instruments, apparatus for galvano-plastics, etc., and lamps of the Gramme system.

Hall 18 contains a highly interesting museum of historical instruments of electricity. The light is furnished by Messrs. Mignon and Rouart.

Hall 19 will be lighted by a company from Lyons, displaying the processes of Lontin, Bertin and Mersanne, and also contains the electro-pneumatic clocks of Mr. Mayrhofer, which form one of the most interesting parts of the electrical exhibition.

Hall 20 contains a retrospective museum and a library of works on electricity; the light in the former will be furnished by Mr. James Fyfe, that in the latter by Mr. Daft.

Hall 21 serves as a restaurant and is ornamented by a large chandelier containing Swan's incandescent lamps.

Hall 22 serves as a reading-room and will be lighted by the Brush system.

Hall D is the place where the Congress will meet, and halls 23 and 24 contain the exhibition of Edison, of which I shall not now speak in detail, reserving a description for a special letter, when I will attempt to do justice to this interesting exhibit. GUSTAVE GLASER, *Ph. D.*

PARIS, *August* 17, 1881.

THE AMERICAN CHEMICAL SOCIETY.

The first meeting of the American Chemical Society, after the summer vacation, was held on Friday evening, September 2, with Vice-President Leeds in the chair. The minutes of the previous meeting were duly passed on and Dr. H. Endemann elected to the position of Editor of the Journal. The first paper presented to the Society was "On the Detection of Oleomargarine," by Mr. P. Casamajor. This method is based on the differences between the density of butter and oleomargarine. A drop of the suspected fat is melted and poured into alcohol at 15°C; if it is butter, on account of its greater specific gravity, it immediately sinks to the bottom of the vessel, while if it is oleomargarine it remains on the surface.

Mr. Casamajor followed by a second paper on the "Detection of Sugar House Syrups from Starch Sugar Syrups." The author found that by dissolving the given sample (10c.c. are taken) in three times its volume of methylic alcohol, the ordinary sugar syrup will become entirely dissolved, while the starch sugar syrup becomes precipitated under the same conditions. Partially dissolving indicates, of course, a mixture of both.

"A Short Table for Testing Sugar by Inversion" was the title of the third paper. It was also by Mr. Casamajor. Assuming that $D =$ the first deviation in a reading of a polariscope and $-D'$ the second, substracting them we have $D + D'$.

$t =$ the temperature.

When a solution of pure sugar is 100, the sum of the two readings will equal 144. Making Δ equal to the

true deviation, we have from the above constants $\Delta = D + D' \times \frac{100}{144-t}$.

In the table given by Mr. Casamajor the quantities which t was equal to was given, so that by a simple calculation it became readily possible to determine the value of the true deviation. The table was based on the much larger one of Clergets.

The fourth paper of the evening was by Mr. A. H. Elliot and it consisted of a description of "A New Form of Apparatus for the Analyses of Gases." It was very severely criticised by Dr. Endeman as being decidedly inferior to the more complicated forms devised by Professor Hempel. M. B.

THE SUCCESSFUL ADMINISTRATION OF NITROUS OXIDE AS AN ANÆSTHETIC FOR DENTAL AND SURGICAL OPERATIONS.*

DR. E. P. HOWLAND, Washington, D. C.

The successful administration of nitrous oxide consists in administering it to patients in such a manner that during operations they will not suffer pain, and that they will be in such a condition that the dentist and surgeon can successfully perform the operation and afterwards that the patients are found not to be injured by its administration. The first requisite for success is that the nitrous oxide should not have more than one per cent of pure oxygen or three per cent of atmospheric air, and that it should be perfectly free from all other gases or vapors. Nitrous oxide with two per cent or more of pure oxygen or five per cent or more of atmospheric air, will not produce perfect anæsthesia and the patient will feel the pain of the operation and pronounce the gas a failure. The adding of one per cent of pure oxygen to nitrous oxide has the benefit of partially oxygenating the blood and in a measure preventing the spasmodic action of the muscles and at the same time produce satisfactory anæsthesia. According to experiments made in France by P. Bert, ten per cent of oxygen or fifty per cent of atmospheric air can be added to nitrous oxide to oxygenate the blood, and at the same time produce perfect anæsthesia if it is breathed in a chamber under a pressure of two atmospheres. A certain amount of nitrous oxide taken into the lungs is necessary to produce insensibility, and it can be diluted with any innocuous gas and still produce anæsthesia, provided this amount is inhaled in the given time. Under pressure in a chamber more gas is breathed in a given time, as the nitrous oxide is condensed the same as the air in the chamber and under a pressure of two atmospheres, two volumes of nitrous oxide would be condensed into one volume, so that the nitrous oxide could be diluted with equal measures of atmospheric air and still the quantity of nitrous oxide inhaled would be the same as if breathed ordinarily and the quantity of oxygen breathed sufficient to arterialize the blood. Rapid breathing of nitrous oxide produces quick anæsthesia, but nothing is gained by it in practice. It is very difficult to produce anæsthesia with nitrous oxide at high elevations above the ocean, because the low pressure of the atmosphere allows the gas to expand so that a less quantity is taken into the lungs in a given time than is required to produce insensibility. Valve inhalers have generally proved a failure, because they admit atmospheric air with the gas in sufficient quantity to to prevent perfect anæsthesia. As near as I can ascertain, more than one-half of all the dentists of the United States who have used nitrous oxide have abandoned its use on account of want of success in producing satisfactory insensibility and thereby injuring instead of benefiting their practice. One cause of failure is the unskillful administration of the gas in allowing air to be inhaled with it, by not having the lips closed tight around the inhaler, and other causes; not using the nose as a valve for expiration exactly at the right time; not stopping the administration at the point of greatest anæsthesia and not having sufficient self-possession under all circumstances and emergencies to know just what to do and when to do it. But the greatest cause is the failure of producing perfect anæsthesia from the mixture of atmospheric air in the nitrous oxide that has been kept in a gasometer over water for a few days. The gas becomes mixed with air through the medium of the water and defective gasometers and cocks. The trouble and cost of making fresh gas every few days has caused the great abandonment of its use. Skillful administrators, who have a large practice and make fresh gas before deteriorated by air, are making nitrous oxide a success. Other dentists can make gas a success by obtaining it condensed in cylinders, when the gas will keep unadulterated and unchanged for years. The only drawback to a paying success is the present great cost of the condensed gas, which in the small cylinders amounts to about thirty-five cents for each administration, when the gas can be made in the dentists' laboratory for about three and a half cents for each administration. An apparatus can now be obtained that enables each dentist to make and condense his own gas and keep it for any length of time. Physicians and surgeons do not use nitrous oxide on account of the trouble and cost of making and keeping it, and the greater amount of practice and skill required in its successful administration than with the more dangerous ether and chloroform. Nitrous oxide requires a costly apparatus to manufacture it, and bulky receptacles to hold and administer it from, and the gas is for sale in but two places in the United States, while ether and chloroform can be carried in a bottle in the pocket and purchased at every drug store in the land. Nitrous oxide can be administered with almost absolute safety, while ether and chloroform can point to their victims in every city and hospital. Money, labor and skill can make nitrous oxide successful with both dentist and surgeon, and taking into account the value of human life, nitrous oxide should stand at the head of all anæsthetics, and its practical use be encouraged instead of ether and chloroform.

I have administered nitrous oxide in over thirty thousand cases for dental and surgical operations, and have had uniform success. I have never had a case of injury from lung or heart disease, but in many cases of throat and lung diseases a marked and permanent improvement. I have kept a large number of patients perfectly anæsthetic for surgical operations from five to thirty-five minutes, and the pulse during these operations has been nearly uniform and full. The success of prolonged operations consists in first producing perfect anæsthesia and then breathing air to arterialize the blood and before consciousness returns again breathing nitrous oxide, the necessary intervals varying in different patients from one-fourth to one-half minute. The average length of time occupied in dental operations from the first commencement of breathing the gas till return of consciousness has been two minutes. To encourage and make nitrous oxide a greater success in the future, the dental and medical colleges should employ successful operators to lecture and instruct graduates so that the particular knowledge and skill acquired by them in practice can be learned by others.

* Read before the A. A. A. S., Cincinnati, 1881.

ON October 17 next, fifty years will have elapsed since Prof. Bunsen, the eminent chemist, received his doctor's diploma from Göttingen University. He, however, intends to absent himself from Heidelberg on the day in question, in order to avoid all congratulations and speech-making.

MR. W. H. M. CHRISTIE, F. R. S., First Assistant at Greenwich Observatory, has been appointed Astronomer Royal, in succession to Sir George Airy, who retires after holding the office for nearly half-a-century.

SOME NEEDED REFORMS IN THE USE OF BOTANICAL TERMS.*

By CHARLES E. RIDLER, M.A., Master of High School, Kingston, Mass.

I.

Seventy per cent of 700 examined species and varieties of "flowering plants," and 65 per cent of all the "flowerless plants," as given in Mann's Catalogue, have different names; 3646 "flowering plants" and 178 "flowerless" are given in the list. If to these per centages, the names of the genera and orders be added, there will be a total of more than 4000 different ones to be remembered, east of the Mississippi; and if collections are made elsewhere, the number becomes appalling. Only 14 names are used five times or more, and over 50 per cent are used but once; that is, among the flowering plants every other name is new, and among the flowerless two out of every three are new.

Many of the specific names describe the plants as being "like" some other plant or thing, and both Latin and Greek terms are employed to do this. Thus, over a hundred different specific names were found ending in *folium* or *phyllon* (leaf), and *oides* (like)[1] Among some other things noted are the following: Adjectives are frequently used in their different degrees of comparison without any meaning whatever; there is a great diversity in the use of proper names of persons, countries and States; specific words are frequently found differing only in their endings and not in their roots; one English word is often described by several Latin, with only a slight difference in meaning, and the question is whether one word might not be used in place of several given in a set[2]; Greek and Latin names exist with the same meaning; Greek and Latin terms are used to describe the same plant; double specific names, and similar specific and generic terms are common; occasionally a term is employed which denotes a specific difference far more common than it is used; and many compound and coined words of doubtful authority[3] are scattered throughout the list—in all of which there is a great need of reform. The plan is suggested, at least in this country, and especially for use in the school-room, of having in the study of botany nothing but English words for the English-speaking race. If Greek and Latin, however, are to be retained, they should be kept in their purity. These reforms in the use of botanical nomenclature are urged for the great mass of tired students of both sexes, and their teachers, in the United States, rather than for the eminent botanists and horticulturists, who may remonstrate against any change which will rob the science of its choicest literature.

THE *Révue Industrielle*, in a recent number, gives a curious instance of the spontaneous galvanization of an engine piston, which took place at Cette, Hérault. The boiler having become much encrusted, some scraps of zinc were introduced to loosen the coating. Several days afterwards, the piston began to work with difficulty; when it was taken out, it was found to be covered with a thick coating of copper. This is supposed to have occurred from the particles of zinc carried with the steam into the copper steam-pipes forming a number of minute galvanic elements in combination with the copper; the vibration of the piston then attracted the copper molecules to itself, whilst the heat and the electric properties of the steam are considered to have facilitated their attachment to it.

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* Read before the A. A. A. S., Cincinnati, 1881.

[1] With *folium: Alismae*, *apii*, *alni*, *bellidi*, *delphini-ilici*. *myrti*, *parnassi*, *primulæ*, *rosmarini*, etc., etc.; with *phyllon: tricho*, *argo*, *chryso*, *lepto*, *rhizo*, *lepido*, etc., etc.; with *oides*: *anemon-lunarin*, *scirp*, *hesperid*, *cheiranth*, *melilot*, etc., etc.

[2] Such as, *Vulgaris*, *officinalis*, *vulgata*, *media*, *communis* (common); *sylvestris*, *nemorosa*, *sylvatica* and the like.

[3] The paper gave a long list of words used by botanists which cannot be found in the lexicon, such as *grandiflora*, and other compounds of *flos; arabisans*, *advensis*, *cucullaria*, *variolaris*, *cataria*, *asprellum*, *lateri—folia* and other compounds of *folia; salina*, *atro-purpurea*, and others.

BOOKS RECEIVED.

THE ANCIENT BRONZE IMPLEMENTS, WEAPONS AND ORNAMENTS OF GREAT BRITAIN AND IRELAND, by JOHN EVANS, D. C. L., LL. D., F. R. S., &c. D. Appleton and Company, 1, 3, and 5 Bond street, New York, 1881.

As Dr. Evans admits, the period covered by the Bronze age cannot be fixed within a precise limit, especially for any particular country. Through the successive stages of civilization, when the Stone period gave way to that of the bronze period, and was succeeded by the Iron, a long course of years must have passed, and even in any particular district the change could not have been sudden.

There must, therefore, have been a time when in each district the new phase of civilization was introduced, and the old conditions had not been changed; the three stages of progress represented by the Stone, Bronze and Iron periods, like the three principal colors of the rainbow, overlapping and intermingling one with the other, through their succession.

In discussing the chronological position of the bronze-using period, the possible use of copper unalloyed with tin, cannot be overlooked; in fact the probability that native copper may have continued for a lengthened period before it was discovered that the addition of a small portion of tin rendered it not only more fusible but added to its elasticity and hardness, must be apparent to all. While dwelling on this point Dr. Evans points out that even after the advantages of the alloy over the purer metal were known, the local scarcity may at times have caused so small a quantity of that metal to be employed, that the resulting mixture could hardly be recognized as bronze; or at times the dearth may have necessitated the use of copper alone, either native or as smelted from the ore.

Of this Copper Age, however, but feeble traces are to be found in Europe, if, indeed, any can be said to exist, but in India important discoveries have been made of copper instruments; these, however, were accompanied with ornaments of silver, which appeared to mitigate against their extreme antiquity, as the production of silver involves a considerable amount of metallurgical skill, and probably an acquaintance with lead and other metals.

The most instructive instance of a Copper Age, as distinct from one of Bronze, is that which has been discovered in our own country, where we find good evidence of a period when, in addition to stone as a material from which tools and weapons were made, copper also, was employed, and used in its pure native condition without the addition of any alloy. The State of Wisconsin alone, has furnished upwards of a hundred axes, spear heads and knives formed of copper, and to judge from some extracts from the writings of the early travellers given by the Rev. E. F. Slafter, that part of America would seem to have entered on its Copper Age long before it was first brought into contact with European civilization, towards the middle of the sixteenth century. On some parts of the shores of Lake Superior native copper occurs in great abundance, and no doubt attracted the attention of the early occupants of the country, who undoubtedly availed themselves of its ductile property to produce spear-heads and other weapons.

To those who have supposed that iron, which is a simple substance and easily produced from its ores, may have been in use before copper; the author replies, that without denying the abstract possibility that in some parts of the globe such might have been the case, he considers that among the nations occupying the shores of the Mediterranean—a part of the world which may be regarded as the cradle of European civilization—not only are all archælogical discoveries in favor of the suc-

cession of iron to bronze, but even historical evidence supports their testimony.

The study of this subject necessarily involves an investigation relating to the date when man first became acquainted with the methods of working the various metals, and the reader will find in this work a carefully prepared synopsis of all the evidences bearing on their disputed points. The introductory chapter describing this controversy will be found one of the most interesting and instructive in the book.

The great body of the work is devoted to an examination and description of the various forms of Bronze weapons and instruments which have been found in the British Isles, treating separately the different classes of instruments, intended each for special purpose, and at the same time pointing out their analogies with instruments of the same character found in other parts of Europe. To bring this department within the comprehension of all readers, Dr. Evans has presented five hundred and fifty superb wood engravings of specimens; thus the archæologist who possesses this work, finds himself, as it were, passing through a museum of Bronze antiquities, aided by the friendly guidance of one who is a master of the subject, and capable of pointing out important details and characteristics, even in the most ordinary implements, which, to the cursory observation of a student, would appear devoid of meaning.

Dr. Evans concludes this interesting work with a chapter on the chronological arrangements of the various types of bronze, and an examination of the various means at our command for fixing the *approximate* date and duration of the period. On the latter point, after what we have stated on the subject, no surprise need be expressed when we state, that Dr. Evans offers an opinion only with great reserve. Subject to this reservation, we find that he attributes eight or ten centuries as the total duration of the Bronze Period, placing the beginning some 1200 or 1400 years before the Christian era. It is questionable whether such an antiquity will meet all the necessities of the case, for as Professor Evans himself points out, it is difficult to believe that the Phœnicians, or those who traded with them, landed in Britain and spontaneously discovered tin.

This work will prove to be of the highest value to archæologists and to all who would trace the course of human progress to its earliest phases. Its general arrangement is most excellent, and adapted for practical work. In addition to a general index, a geographical and topographical index is presented, which greatly adds to the value of the work. The publishers have performed their part of the work most efficiently, and have produced a handsome volume, illustrated in the highest style of the engravers' art, which will in future be held as an authoritative work of reference, and a store-house of facts from which the student and specialist may draw material of the highest value.

IT has been resolved to invite the British Association to meet in Aberdeen in 1883. The invitation will be presented at the forthcoming meeting of the Association at York. The Association will meet in Southampton in 1882, and an influential local committee has already been appointed.

THE Government of India has declined for the present to award the prize of £100 offered for the best "manual of hygiene" for the use of the British soldier.

METEOROLOGICAL REPORT FOR NEW YORK CITY FOR THE WEEK ENDING SEPT. 3, 1881.

Latitude 40° 45′ 58″ N.; Longitude 73° 57′ 58″ W.; height of instruments above the ground, 53 feet; above the sea, 97 feet; by self-recording instruments.

AUGUST AND SEPTEMBER.	BAROMETER. Mean for the day. Reduced to Freezing.	Maximum. Reduced to Freezing.	Maximum. Time.	Minimum. Reduced to Freezing.	Minimum. Time.	THERMOMETERS. Mean. Dry Bulb.	Mean. Wet Bulb.	Maximum. Dry Bulb.	Time.	Maximum. Wet Bulb.	Time.	Minimum. Dry Bulb.	Time.	Minimum. Wet Bulb.	Time.	Maxi'm In Sun.
Sunday, 28	30.020	30.088	0 a. m.	29.990	4 p. m	76.3	69.0	89	4 p. m.	75	4 p. m.	67	6 a. m.	64	7 a. m.	139.
Monday, 29	30.102	30.128	12 p. m.	30.032	0 a. m.	76.0	70.0	86	3 p. m.	74	5 p. m.	67	5 a. m.	66	5 a. m.	139.
Tuesday, 30	30.129	30.190	9 a. m.	30.086	5 p. m.	77.6	72.0	85	4 p. m.	75	4 p. m.	70	5 a. m.	68	5 a. m.	135.
Wednesday, 31	29.988	30.100	0 a. m.	29.900	12 p. m.	82.7	73.3	93	4 p. m.	78	4 p. m.	72	6 a. m.	68	6 a. m.	140.
Thursday, 1	29.823	29.900	0 a. m.	29.780	12 p. m.	81.0	72.6	87	1 p. m.	76	1 p. m.	75	6 a. m.	70	6 a. m.	131.
Friday, 2	29.786	29.800	9 p. m.	29.748	4 p. m.	73.3	69.3	78	3 p. m.	71	3 p. m.	68	12 p. m.	66	12 p. m.	97.
Saturday, 3	29.864	29.966	11 p. m.	29.800	0 a. m.	69.6	65.3	74	3 p. m.	68	3 p. m.	66	7 a. m.	63	7 a. m.	128.

Mean for the week .... 29.958 inches.
Maximum for the week at 9 a. m., August 30th .... 30.190 "
Minimum " at 4 p. m., Sept. 2d .... 29.748 "
Range .... .442 "

	Dry.		Wet.	
Mean for the week	76.6 degrees	....	70.2	degrees.
Maximum for the week, at 4 pm. 31st	93.	" at 4 pm 31st,	78..	"
Minimum " " 7 am. 3d	66.	" at 7 am 3d,	63	"
Range " "	27.	"	15.	"

AUGUST AND SEPTEMBER	WIND. Direction. 7 a. m.	2 p. m.	9 p. m.	Velocity in miles. Distance for the Day.	Force in lbs. per sqr. feet. Max.	Time.	HYGROMETER. Force of vapor. 7 a. m.	2 p. m.	9 p. m.	Relative humidity. 7 a. m.	2 p. m.	9 p. m.	CLOUDS. Clear, 0; Overcast, 10. 7 a. m.	2 p. m.	9 p. m.	RAIN AND SNOW. Depth of rain and snow in inches. Time of Beginning.	Time of Ending.	Duration. h. m.	Amount of water	OZONE. 0–10
Sunday, 28	w. s. w.	s.	e. s. e.	94	½	3.15 pm	.543	.623	.679	79	48	81	3 cir.	0	0	-----	-----	-----	--	0
Monday, 29	e. n. e.	s. s. e.	s. s. e.	102	1	2.30 pm	.622	.650	.693	85	54	85	0	1 cir.	5 cu.	-----	-----	-----	--	0
Tuesday, 30	s. s. e.	s. s. e.	s. s. w.	103	2⅛	9.50 pm	.682	.746	.704	90	64	73	10	0	3 cir.	-----	-----	-----	--	0
Wednesday, 31	w. s w.	s. s. w.	s. w.	187	2¾	2.00 am	.631	.724	.746	80	48	64	3 cir.	0	0	-----	-----	-----	--	1
Thursday, 1	w.	w.	s. w.	179	1½	9.50 pm	.666	.705	.703	77	55	66	0	9 cu.	10	-----	-----	-----	--	3
Friday, 2	n. n. w.	e.	e.	114	1	1.40 am	.668	.678	.644	85	73	85	10	10	10	4.40pm	5.30pm	0.50	.05	0
Saturday, 3	n. n. e.	e.	s. e.	104	¾	4.20 pm	.536	.604	.564	84	72	79	8 cu.	4 cu.	8 cu.	-----	-----	-----	--	1

Distance traveled during the week .... 883 miles.
Maximum force .... 2¾ lbs.

Total amount of water for the week .... .05 inch.
Duration of rain .... 00 hours, 50 minutes.

DANIEL DRAPER, Ph. D.

Director Meteorological Observatory of the Department of Public Parks, New York.